

- b. applying the mixture onto at least one substrate with a predetermined surface condition to form a layer with a predetermined thickness while maintaining the mixture at mesomorphic phase,
- c. forming a film with a specular narrow band Bragg reflection,
- d. cooling the film to the room temperature at a predetermined speed,
- e. maintaining a sufficiently low temperature for a controllable duration to let the first polymeric liquid crystal and the second polymeric liquid crystal partially separated into a plurality of discrete microchips,

wherein the microchips having a plurality of reflection wavelengths are dispersed at least two dimensionally in the cholesteric film as a result of the thermo phase separation of the polymeric liquid crystals;

whereby a broadband diffusively reflective polarizer is formed.

2. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the layer with predetermined thickness has the thickness in the range of 5 ~ 40 μm .
3. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the sufficiently low temperature is in the range of $-30 \sim 30^{\circ}\text{C}$.
4. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the controllable duration is in the range of 1 ~ 24 hours.
5. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the homogenous mixture is also including a UV initiator.
6. The method of fabricating a diffusively reflective polarizer as in claim 1 further including a UV-beam exposure step to make the polarizer high-temperature stable.
7. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the first polymeric liquid crystal and the second polymeric liquid crystal have different mesomorphic structure.
8. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the first polymeric liquid crystal and the second polymeric liquid crystal have different physic-chemical miscibility.
9. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the cholesteric film is a thermoplastic polymer.

10. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the cholesteric film is a UV cureable thermo-set polymer.
11. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the discrete microchip is a composite structure of polymeric liquid crystals with different proportion.
12. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the discrete microchip has a diameter in the range of 5 ~ 30 micrometer.
13. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the discrete microchips have at least two dimensional randomized distributions within the cholesteric film.
14. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the phase separation is a thermo phase separation.
15. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the broadband diffusively reflective polarizer reflects a circular polarization covering substantially the visible bandwidth.
16. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the broadband diffusively reflective polarizer reflects a circular polarization covering at least a portion of the invisible bandwidth.
17. The method of fabricating a diffusively reflective polarizer as in claim 1 wherein the narrow band Bragg reflection and the broadband diffusive reflection is inter-convertible.
18. The method of fabricating a diffusively reflective polarizer as in claim 17 wherein the conversion from broadband to narrow band is through the phase unification process.

4. Version with markings to show changes made

Claims: I claim:

1. A diffusively reflective polarizer comprising:
 - a. a cholesteric film of at least two polymeric liquid crystals having a discrete microchip structure, and
 - b. at least one alignment layer attached to at least one surface of the film;

wherein a plurality of microchips having discrete reflection wavelengths are dispersed at least two dimensionally in the cholesteric film confined by the alignment layer as a result of a phase separation process of the polymeric liquid crystals;

whereby a silver white broadband reflection of circular polarization with an approximately hemispherical viewing angle is displayed on the polarizer.

2. The diffusively reflective polarizer as in claim 1 wherein the polymeric liquid crystals have different mesomorphic structure.
3. The diffusively reflective polarizer as in claim 1 wherein the polymeric liquid crystals have different physic-chemical miscibility.
4. The diffusively reflective polarizer as in claim 1 wherein the cholesteric film is a thermoplastic polymer.
5. The diffusively reflective polarizer as in claim 1 wherein the cholesteric film is a UV cureable thermo-set polymer.
6. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure is a composite structure of polymeric liquid crystals with different proportion.
7. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure has a diameter in the range of 5 ~ 30 micrometer.
8. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure has at least two dimensional randomized distribution within the cholesteric film.
9. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure has a symmetry helical axis which is normally distributed along the normal direction of the cholesteric film.
10. The diffusively reflective polarizer as in claim 1 wherein the phase separation is a thermo phase separation.
11. The diffusively reflective polarizer as in claim 1 wherein the broadband reflection of circular polarization covers substantially the visible bandwidth.
12. The diffusively reflective polarizer as in claim 1 wherein the broadband reflection of circular polarization covers at least a portion of the invisible bandwidth.
13. A method of fabricating a diffusively reflective polarizer comprising the step of:

- a. forming a substantially homogenous mixture of the first polymeric liquid crystal and the second polymeric liquid crystal at a sufficiently high temperature,
- b. applying the mixture onto at least one substrate with a predetermined surface condition to form a layer with a predetermined thickness while maintaining the mixture at mesomorphic phase,
- c. forming a film with a specula narrow band Bragg reflection,
- d. cooling the film to the room temperature at a predetermined speed,
- c. maintaining a sufficiently low temperature for a controllable duration to let the first polymeric liquid crystal and the second polymeric liquid crystal partially separated into a plurality of discrete microchips,

wherein the microchips having a plurality of reflection wavelengths are dispersed at least two dimensionally in the cholesteric film as a result of the thermo phase separation of the polymeric liquid crystals;

whereby a broadband diffusively reflective polarizer is formed.

- 14. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the layer with predetermined thickness has the thickness in the range of 5 ~ 40 μm .
- 15. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the sufficiently low temperature is in the range of $-30 \sim 30^{\circ}\text{C}$.
- 16. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the controllable duration is in the range of 1 ~ 24 hours.
- 17. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the homogenous mixture is also including a UV initiator.
- 18. The method of fabricating a diffusively reflective polarizer as in claim 13 further including a UV-beam exposure step to make the polarizer high-temperature stable.
- 19. A method of fabricating an inter-convertible polarizer comprising the step of:
forming a substantially homogenous mixture of the first polymeric liquid crystal and the second polymeric liquid crystal at a sufficiently high temperature,
 - a. applying the mixture onto at least one substrate with a predetermined surface condition to form a layer with a predetermined thickness while maintaining the mixture at mesomorphic phase,
 - b. forming a film with a specula narrow band Bragg reflection,

- c. cooling the film to the room temperature at a predetermined speed,
 - d. maintaining a sufficiently low temperature for a controllable duration to let the first polymeric liquid crystal and the second polymeric liquid crystal partially separated into a plurality of discrete microchip structure,
 - e. heating the polarizer film in the predetermined area at a sufficiently high temperature to make the discrete microchip structure to the homogenous cholesteric structure,
 - f. repeating step d., and e.,
whereby the diffusively broadband polarizer and the specula narrow band polarizer is interchangeable to each other.
20. The method of fabricating an inter-convertible polarizer as in claim 19 wherein the conversion from narrow band polarizer to broadband polarizer is through the phase separation step.
 21. The method of fabricating an inter-convertible polarizer as in claim 19 wherein the conversion from broadband polarizer to narrow band polarizer is through the phase unification step.
 22. The method of fabricating an inter-convertible polarizer as in claim 19 wherein the step of heating the polarizer film in a predetermined area is a thermo-scan imaging process.
 23. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the first polymeric liquid crystal and the second polymeric liquid crystal have different mesomorphic structure.*
 24. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the first polymeric liquid crystal and the second polymeric liquid crystal have different physic-chemical miscibility.*
 25. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the cholesteric film is a thermoplastic polymer.*
 26. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the cholesteric film is a UV cureable thermo-set polymer.*
 27. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the discrete microchip is a composite structure of polymeric liquid crystals with different proportion.*

28. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the discrete microchip has a diameter in the range of 5 ~ 30 micrometer.*
29. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the discrete microchips have at least two dimensional randomized distributions within the cholesteric film.*
30. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the phase separation is a thermo phase separation.*
31. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the broadband diffusively reflective polarizer reflects a circular polarization covering substantially the visible bandwidth.*
32. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the broadband diffusively reflective polarizer reflects a circular polarization covering at least a portion of the invisible bandwidth.*
33. *The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the narrow band Bragg reflection and the broadband diffusive reflection is inter-convertible.*
34. *The method of fabricating a diffusively reflective polarizer as in claim 33 wherein the conversion from broadband to narrow band is through the phase unification process.*

Very respectfully,

Applicants:


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